THE ETIOLOGY OF TUBERCULOSIS OF THE UPPER RESPIRATORY TRACT.*

BY GEORGE BACON WOOD, M.D., PHILADELPHIA.

The great factor in the etiology of the disease, tuberculosis, is infection with the specific germ, the tubercle bacillus. Tuberculosis of all organs has, of course, this common feature, and for the sake of conciseness the discussion of the etiology of tuberculosis of any individual organ or set of organs should not include the morphology and pathologic power of the tubercle bacillus, but rather be confined to the peculiar resistance which the organ under discussion offers to the invasion of this germ. As far as the nose and throat are concerned certain portions are peculiarly resistant to bacterial invasion, while other portions are comparatively easily invaded. This variation in resistance depends both on the anatomy and the physiology of the different parts.

When we consider that the large majority of individuals breathe through the nose, and that the air which is forced through the nasal passages has been practically filtered free from dust and bacteria by that organ, it seems remarkable that tuberculosis of the interior of the nose is so comparatively rare.

St. Clair Thomson and Hewlitt experimented with an apparatus which enabled them to collect the air as it came out through the choanæ. In a given quantity of laboratory air they found 29 mould spores and 9 bacteria; whereas, after the same quantity of air had passed through the nose it contained only 2 mould spores and no bacteria. This experiment was confirmed again and again. The question naturally arises, what becomes of those organisms which lodge in the nose as the result of this filtration? The same experimenters placed a pure culture of the Bacillus Prodigiosus on the septum well within the vestibule. A diminution in the number of bacteria could be noticed within fifteen minutes, and practically no trace of the bacteria could be detected after eighty minutes; and after two hours had elapsed in no case could any growth be obtained in cultures from the spot inoculated.

This opposition of the nasal mucous membrane to the growth of bacteria was also demonstrated by Malatto. Piaget declared that the nasal cavity, with the exception of the vestibules, both in man and animals, is nearly free from germs. He says that this asepsis is largely dependent upon a bactericidal action of the nasal mucus, and that this mucus is absolutely fatal to the anthrax bacillus, the diphtheritic bacillus, some forms of streptococcus and staphylococcus, the colon bacillus and some other germs. Inglauer, on the other hand, states that normal nasal mucus does contain a certain number of bacteria, but he admits that the nasal fossa rids itself of a large number of the bacteria inspired. Wurtz and Lermoyez, in a recently published research, again demonstrated that the nasal mucus is bactericidal to the anthrax bacillus and to other germs to a greater or less extent. They obtained the nasal mucus from normal individuals by placing bits of packing in the nasal fossæ, the fossæ having been previously washed out and cleansed. The mucus in the fresh state and also after it had undergone sterilization was mixed with bouillon containing anthrax bacilli, and even after three weeks of incubation no growth could be found, and inoculated guinea pigs gave negative results. Parker and Wright, however, found the nose sterile in only 6 out of 36 normal individuals, but the non-sterile cases gave very few colonies.

---

* Read before the Thirteenth Annual Meeting of the American Laryngological, Rhinological and Otological Society, New York City, May 30, 31, and June 1, 1907.

In summing up the evidence which I have just gone over, it would seem that the mucous membrane of the nasal fossæ exerts an inhibitory influence upon most bacteria, and that most probably this inhibitory influence is due to the bactericidal action of the nasal secretion. It must not, however, be supposed that the nasal mucus is equally antagonistic to all germs, and it concerns us especially to determine if possible its action on the tubercle bacillus.

Strauss, in 1894, found virulent tubercle bacilli in the nasal cavities of persons who, not having tuberculosis themselves, were in more or less constant attendance upon tuberculous patients. The dirt, solid particles and mucous contents of the nasal cavities were removed by sterile cotton swabs from twenty-nine persons, including hospital patients, internes, and patients suffering from chronic maladies other than tuberculosis. The inoculations made with the material thus obtained showed that about 40% of persons examined had virulent tubercle bacilli in their nasal cavities.

Freudenthal, in 1896, investigated the naso-pharynx of 133 patients, 52 of whom were tuberculous and 81 suffering from some other diseases. Tubercle bacilli were found in all of the 52 tuberculous patients, and in 9 out of the 81 non-tuberculous.

In 1900, Jones removed the dust and crusts from the nasal mucosa, making inoculation tests with the material thus obtained.

Thirty-one animals were used. The majority died of some unknown infection, but three showed distinct tuberculosis.

Lake holds that the nose very seldom forms a mode of entrance for the tubercle bacillus into the body. Under his direction, Lucas made cover-glass preparations from the nasal cavities of 50 tuberculous patients, in all of whose sputum tubercle bacilli were present. In only one case were tubercle bacilli found, though 80% of these cases showed some form of organism.

Guinea pig inoculations made by myself from four persons who had been more or less in contact with tuberculous patients gave negative results. I obtained the material by swabbing the floor of the nasal cavities with sterile cotton-wrapped applicators, washing them off in sterile water, and inoculating this water into the abdominal cavities of guinea pigs.

In a certain per cent of persons undoubtedly virulent tubercle bacilli will be found in the nasal cavity, but that they stay there for any length of time is not probable, so that tuberculosis of the nasal fossæ should be a comparatively rare condition.

Knight says that up to 1901 there had been 108 cases of tuberculosis of the nose reported. Ernst Pasch in 1905 reports 17 cases coming under his own observation. Other sporadic cases have been reported since then, among them one by Onodi and Rossi, and one by Marcelli, both of which were supposed to be primary.

It is very likely that a large number of cases of tuberculosis of the nose are overlooked, but even then it is remarkable that so few cases have been reported. A case of primary tuberculosis of the nose would, on account of its infrequency, undoubtedly be published. 'Personally I have never seen a case of primary tuberculosis of the nasal fossæ, and though I have had a fairly large experience during the last three or four years in examining the nasal cavities of cases of pulmonary tuberculosis at the Phipps Institute, I have seen very few secondary involvements.

Summing up, it would seem that the nasal cavities are only rarely infected with the tubercle bacillus, probably because the time necessary for the propagation of this slow-growing organism permits the cilia of the nose and the nasal secretions to remove it from the fossæ; but it is also very likely that the nasal secretions themselves are directly inhibitory to its growth.

Tuberculosis of the pharynx should be considered as practically identical with tuberculosis of its lymphoid tissue. I doubt if the stratified squamous pavement epithelium, washed continually with a downward flow of mucous, is ever infected by the tubercle bacillus, except through the lymph-follicles, the lateral folds of the pharynx or one of the four tonsils. Statistics on pharyngeal tuberculosis are of little value in confuting or supporting this statement, because the large majority of writers have not differentiated between an ulcer on the lymph-follicles or the lateral folds from one situated between these structures. If we include under the term "pharyngeal tuberculosis" lesions of its lymphatic tissue then tuberculosis of the pharynx is not very rare.

There is a great discrepancy in the reported percentages of secondary pharyngeal tuberculosis, while Levy reports 67 cases in 500 autopsies; Böcher reports only 12 cases in 2950; and Lublinski 5 in 1,600. However, the average percentage of all these cases would be 1.4%, which corresponds pretty closely with the 1% of Guttman.

Sokolowski in 1903 called attention to the frequency with which the lateral folds of the pharynx become tuberculous, and showed that the condition resembles very closely the so-called latent tuberculosis of the tonsils, and like this condition in the tonsils the disease can be diagnosed only after portions have been removed and put under the microscope. In 13 cases of tuberculosis which he examined, 8 showed involvement of the granular tissue of the pharynx or of the lateral folds, that is 61½ per cent.

Cordes speaks of pharyngitis lateralis as the formation of a new small elongated tonsil; meaning by this that hypertrophy of the lateral folds of the pharynx is accompanied not only by hyperplasia of the lymphoid tissue but also by the formation of veritable crypts and follicles. It would seem, therefore, that the discussion of the etiology of tuberculosis of the pharyngeal mucosa would best be included in the discussion of the etiology of tonsillar tuberculosis.

When we come to consider the comparative susceptibility of the various parts of the upper respiratory tract to tuberculosis, preference for liability to infection must be given to the tonsillar tissues. Let us consider the evidence which justifies this proposition. The crypts, which are characteristic of all tonsillar tissue, afford a comparatively open door for microbic invasion. The lumen of the crypt acts almost as an incubator, and the peculiar disintegrated condition of the lining epithelium does not, like the stratified epithelium of the mouth, present a mechanical barrier. The penetration of bacteria into the tonsil parenchyma is prevented almost solely by the vital resistance of the living tissue, and if the pathogenic power of the invading germ is sufficient there is practically no hindrance to its entrance within the confines proper of the human body. Both research work and clinical evidence afford abundant proof of this theory, demonstrating the peculiar susceptibility of tonsillar tissue to infection, and the ease with which virulent micro-organisms may pass through its structures.

The results of all the research work done in relation to general microbic invasion through the tonsils show that in the tonsil more than anywhere else on the body surface, external and internal, the penetration of the invading germ depends not so much upon any mechanical barrier presented by the tissue as upon the relative virulence of the germ. Therefore, because the streptococcus can infect the tonsil it does not follow that the tubercle bacillus can do so, and as we are speaking now only of tuberculosis it is not necessary to go into the details of the work done in relation to general microbic infection through the tonsils.

In active pulmonary tuberculosis there is a certain dosage of tubercle bacilli spread fairly equally over the upper respiratory tract, excepting the nose and nasopharynx, and it is probable that the frequency of secondary infections of the various parts will give a fair index to their relative susceptibility. Permit me to quote from a paper published by myself in 1904. The tonsils of 136 cases of pulmonary tuberculosis were examined by seven different observers, and in 94, tuberculous involvement was diagnosed, that is 69 per cent. The diagnosis in these cases was made chiefly by histologic examination. In very advanced cases of pulmonary tuberculosis the tonsils almost never escape infection. In 9 cases reported in 1904, in which I made post-mortem examination, the tonsils in every one showed tubercle with giant cells, and in 38 cases examined during the past year I found histologic changes typical of tuberculosis in 35, and I believe they would have been found in the remaining 3 if the whole of both tonsils had been sectioned.

This predilection of tuberculosis for the tonsils has been confirmed experimentally by Bamp, Ravenel, and later by myself, In experimenting on hogs, I found that the tonsils could be inoculated by a single swabbing with virulent bovine tubercle bacilli, but not once in the whole series of experiments was there found any lesions in the upper respiratory tract outside of the tonsils.

It would seem that all that is required to produce tuberculosis in the tonsil is to bring in contact with this organ a number of bacilli sufficient to overcome the tissue resistance. Tuberculosis of the tonsils should then be the most frequent form of primary tuberculosis, as both food and air must first pass over these structures before gaining access to the more interior organs, and I believe this is true. In a series of 1671 cases of hypertrophied tonsils, compiled from the published records of twenty-three authors, primary tonsillar tuberculosis was diagnosed in 88, that is 5.2 per cent. I found about the same proportion myself in perfectly unsuspected cases, where the tonsils had been removed by operation and were only casually examined. It would seem safe to assume that at least 5 per cent of children have tuberculosis of the tonsils.

Probably in the majority of cases on which these statistics were based the tonsils examined were removed because of their enlargement, and therefore one is hardly justified on that ground alone in giving 5 per cent as the frequency of tonsillar tuberculosis in all children. We must, however, remember that the size of the tonsil bears no relation to the liability of infection, except that its enlargement presents, as it were, a larger net to entrap the organisms. From my examination of tonsils from persons who had died from pulmonary tuberculosis, the hyperplastic tonsil is apparently more resistant to tuberculous infection than the small tonsil in which there was very little lymphatic tissue. This observation, however, is based upon too insufficient evidence to be accepted in any other light than a suggestive one.

While it is scarcely within the scope of this paper to treat with such a large and important subject as the method of infection in pulmonary tuberculosis, it may be allowable at this time to speak briefly concerning the liability to systemic infection from tuberculosis lesions in the tonsils. Cornet, in an elaborate series of experiments believes he has shown that the tubercle bacillus is capable of producing disease in any organ to which the germ gains access. If a given part of the body is inoculated the lesion develops locally, and is generally promulgated through the lymphatics to the nearest set of lymph nodes. The bacillus is arrested in these nodes and cannot proceed further until destruction of this barrier has been accomplished. When this resistance has been overcome then the infection proceeds to the next chain, and finally via the lymphatics to the venous system. The tonsils may be described as differentiated lymph glands, but it is not probable that they possess the same filtering qualities as the lymph nodes. By rubbing a virulent culture of bovine tubercle bacilli on the surface of the tonsils of the hog, I once succeeded in finding the tubercle bacillus in the regionary lymph gland of the neck within five days after the inoculation, and no demonstrable change could be found in the tonsillar tissue. In this same series of experiments, I further found that histologic changes appeared as early in the cervical lymph node as in the tonsil. Further, we know from clinical experience how quickly the cervical nodes at the angle of the jaw become enlarged and tender during infection of the tonsil, and that for a long time this tenderness is confined to the first set of glands. Hence it is evident that tuberculosis of the tonsils would very likely show the same clinical course as that of tuberculosis of the cervical lymph nodes.

Recently, several articles have appeared concerning the possibility of infection of the apices of the pleura and of the bronchial and mediastinal lymph glands from the upper respiratory tract via the cervical lymph chains. Grober, in 1900, believed he succeeded by injecting the region of the tonsils in living animals with India ink in getting the pigment to travel via the cervical lymph glands to the pleural apices and to the bronchial lymph glands. Fleiner had previously stated that the supraclavicular glands were anatomically directly connected with the other cervical glands, that is the deep lateral chain, and were at the same time regionary to the pleural apices. The clinical support which Grober brings to substantiate his theory is chiefly that the statistics collected from five different observers show that in 14.3 per cent of cases with tuberculosis of the glands of the neck the pleura became involved. There is no doubt that Grober has done a great deal of valuable work in this connection, and from a mere perusal of his paper he seems justified in his conclusion that infection of the pleura may take place via the cervical lymph glands.

During the last year, an article has been published by Beitzke, going over this same subject very carefully, making both anatomical studies and experimental researches, also giving the data furnished by the post-mortem on 55 children. He directly opposes Grober's theory, and criticises his work, believing that his results do not justify his conclusions. His work has been most carefully carried out, and I quote his conclusions.

"1. There exists no lymph vessel leading from the chain of cervical lymph glands to the bronchial glands.

"2. Tuberculous infection of the lungs from the cervical lymph glands can take place only through the lymphatic trunk and the venous system.

"3. This path of infection, at least in children, is without any practical import. The infection of the lungs, and hence the bronchial glands, in children as a rule takes place through aspiration of the tubercle bacillus into the bronchi; a descending cervical tuberculosis may be present incidently.

"4. The aspirated bacilli may be in the respired air but they come from the mouth where they have gained access by food or by contact."

During the past winter I started a series of anatomical studies along the same line but unfortunately have not yet been able to complete them. The results I have so far obtained, however, support entirely Beitzke's claim concerning the connection between the supraclavicular lymph glands and those higher in the neck. On the other hand, in children the arrangement and number of the lymph nodes in the neck is very irregular, and the pleural apices come into fairly close relation not only with the supraclavicular glands but also with the extreme lower portion of the greater vessels of the neck. The deep lateral chain of the neck extends downward along these vessels, and if there should be a node situated in the lower part of the neck, as sometimes occurs, it is conceivable that tuberculosis of this node may infect the pleural apices directly by continuity of structure. It would seem, therefore, possible that the pleural apices may in some few cases be infected by descending tuberculosis of the lymph glands of the neck, but for the tonsillar lesion to reach this distance there are a great many lymph nodes which must first be broken down and overcome. However, Beitzke would probably be correct in the large majority of cases when he says that infection of the lungs may theoretically occur from the cervical lymph nodes but that it would almost always be a miliary lesion due to the entrance of the bacilli into the venous system via the jugular lymph trunk. Miliary infection of the lungs was the only pulmonary lesion in my experiments on hogs, and this occurred only after all the nodes of the cervical lymph chain were broken down.

Another very probable source of systemic infection from local disease of the tonsils, especially from the pharyngeal tonsil, may come from the disintegration or breaking down of the tonsillar tissue and diseased portions being swallowed and inoculating the gastro-intestinal tract or the mesentric glands. A lesion, however, to do this would not belong to the so-called latent type but must be ulcerative and hence recognizable.

To sum up these various conflicting views is somewhat difficult, but it seems to me that as a rule the clinical importance of a tuberculosis lesion in the tonsillar tissues of the throat is about the same as a local tuberculous lesion in any other non-vital portion of the body, which is separated from the internal organs by an intervening chain of lymph nodes.

The etiology of laryngeal tuberculosis has been so extensively discussed of late years that it is hardly worth while to enter upon this subject, especially as I know of no new facts to offer. Probably the best synopsis of the subject will be found in the last edition of Lake's Monograph on Laryngeal Phthisis. I would, however, like to call attention just to a few facts.

It is unquestionable that primary tuberculosis of the larynx has occurred though it is exceedingly rare. Aronsohn has collected 34 cases which he divided into three groups; in the first group, those in which post-mortem examination showed tuberculosis of the larynx without involvement of the lungs, only 3 have been reported; in the second group, there were 9 cases in which were found advanced or old disease of the larynx with recent infection of the lungs; and the last group, 2 cases in number, were based upon clinical examination only. In other words, there has been at the time of Aronsohn's paper only 3 cases reported in which the primary condition of the laryngeal lesion had been anything like proven. Lake says that the term "primary laryngeal tuberculosis" implies an original invasion of the larynx in the absence of any pulmonary phthisis, and does not, necessarily, exclude the presence of some such lesion as a tuberculous adenitis or otitis. To me it would seem better that by the term "primary involvement" it should be understood that the organ under discussion is the first in the body to show any lesion, and that the lesion must be termed secondary if it follows disease of some other organ, no matter how small or insignificant that organ may be. It is easily conceivable that the larynx may be infected from a tuberculous otitis, and such lesions should be placed under the secondary laryngeal infections and not looked upon as primary. Two such cases have been reported by Lake.

The method by which the tubercle bacillus gains a foothold in the laryngeal mucosa probably varies in different cases. In a very few cases the organism may penetrate through the unbroken epithelium, as demonstrated by Wright. It may enter through the gland-ducts, and this is probably the line of infection when the lesions begins in the ventricles. The erosions caused by the traumatism of cough and the constant irritations of large quantities of decomposed sputum may become infected with tubercle bacilli. This method of infection is probably the most common way in ulceration of the true vocal cords. Lake has found in the epithelium minute abscesses, which he believes might finally have become tuberculous. Briggs calls attention to the early erosions as marking the stage where simple catarrhal laryngitis becomes tuberculous. Be the method of penetration what it may, the essential element in the infection is the enormous and constant dosage to which the larynx is subjected.

129 S. 18th St.

The Surgical Reduction of the Excessively Large Ear. CHAS. C. MILLER, Chicago. *Med. Fortnightly*, July 25, 1907.

Dr. Miller asserts from experience that: "There is a demand for men capable of performing operations intended to improve the appearance, and in the regular profession I believe this is the only special field which is not overcrowded. So far as I can learn, I have the world to myself in this respect, and am the only surgeon who performs any considerable number of these operations." To perform any of the operations for reducing the enlarged ear infiltration is all that is required to render them painless, and is accomplished with a very weak cocain solution. The author describes and illustrates with cuts three operations: The crescent-shaped excision, the triangular excision, and the sickle-shaped excision. The last should be performed posteriorly, so that the skin anteriorly is not sacrificed. Essentially it is the excision of a sickle-shaped portion of the cartilage with the posterior part of the integument. It is, in short, a sort of sub-integument resection. All these operations are plainly illustrated by drawings, and the descriptions in the text are brief and clear.

EATON.